AD-A072 106 NAVAL UNDERWATER SYSTEMS CENTER NEW LONDON CT NEW LO--ETC F/G 17/1
U. E. R. D. SHOCK TEST 14-18 DECEMBER 1970 TRANSDUCER SQS-26(BX--ETC(U)
JAN 71 M E EVANS

UNCLASSIFIED NUSC/NL-TM-2330-04-71 NL

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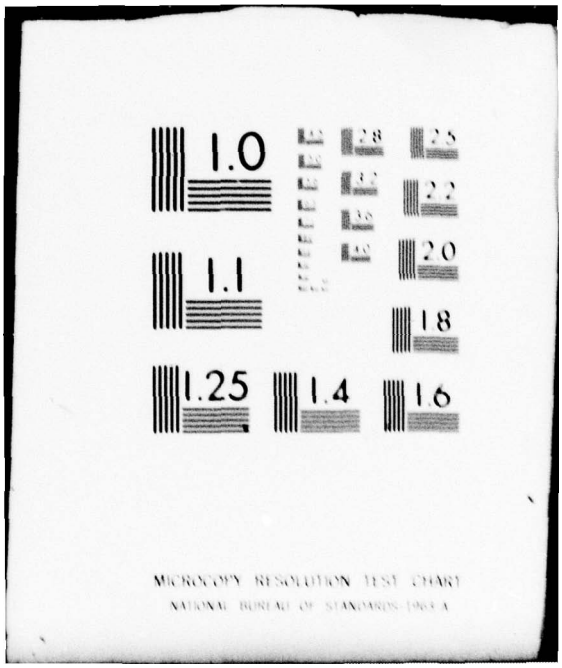
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MOST Project -4

NAVAL UNDERWATER SYSTEMS CENTER

NUSC/NL-TM-2330-04-71

NUSC Problem No. 1A0230000

U. E. R. D. SHOCK TEST 14-18 December 1970 TRANSDUCER SQS-26(BX) EVALUATION

By

Milford E. Evans

NUSC/NL Technical Memorandum No. 2330-04-71

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Technical memo.

INTRODUCTION

The shock test was performed to evaluate the SQS-26(BX) transducers. Other sonar transducers and hydrophones of production and experimental types were also tested. There were 34 units shock tested. These units were produced by six contractors: General Electric Company, Edo Corp., Honeywell Corp., Dyna-Empire, Inc., Hazeltine Corp., and Raytheon Company.

PROCEDURE

The Underwater Explosive Shock Test was performed by the Underwater Explosion Research Division (UERD) of NAVSHIPS R & D Center at the Norfolk Naval Shipyard during the period of 14 December through 18 December 1970. The test consists of four (4) shots using a 90-pound HBX-1 Charge at a depth of 24 feet and standoff distances of 75, 50, 30, and 20 feet, respectively.

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PROCEDURE (cont.)

The transducers were mounted on the Floating Shock Platform (FSP) as indicated in Figure 1. Each unit to be tested was assigned a test position as shown in Appendix A.

All data acquired during the test was recorded by Naval Underwater Systems Center, New London Laboratory (NUSC/NL) personnel (Code 2332). This data consists of Vector Admittance Locus Plots (VALP) of each unit before and after each explosion.

Half-power frequencies and resonant frequencies were taken from VALP's of each unit tested. Using this data, a "Q" value is calculated. "Q" is defined as the resonant frequency divided by the difference of the half-power frequencies. The half-power frequencies, the resonant frequencies, the "Q" value, and the change in resonant frequency for each shot are presented in Appendix B according to test position.

The mounting staves of the SQS-26(BX) units were not all of the same design; Edo Corp. strengthened the shipboard staves, Hazeltine Corp. used a different type stave altogether, and General Electric and Honeywell used the regular shipboard stave.

The General Electric Company used three regular shipboard staves side by side with a 1/4" plate across the bottom; the plate was used to brace the bottom of the staves to the FSP.

Edo Corporation used a single shipboard stave with a 10" channel iron on each side and a 3/8" plate on the bottom. The plate was used to brace the bottom of the stave to the FSP.

Hazeltine Corporation constructed a stave of 8" channel iron with 8" channel iron on the bottom. From the bottom channel to the FSP, a brace was used.

The Honeywell Corporation used a single shipboard stave with a 1/4" plate across the bottom. This plate was also used in bracing the bottom of the stave to the FSP.

The description, serial number, dimensions, weight, service, ship, NAVSEC FSP No., purchase order number, and test position number of each element is shown in Appendix A.

RESULTS

GENERAL ELECTRIC COMPANY SQS-26(BX)

The General Electric units were mounted on the FSP in Test Positions 1 through 6, as shown in Figure 1. Test Position No. 1 was a "Dummy" unit. Test Positions 2 through 5 were SQS-26(BX) units and Test Position No. 6 was a METB-2 unit. For more information, see Appendix A.

The pretest data showed the four SQS-26(BX) units had resonant frequencies of 3651 Hz to 3631 Hz and "Q" values of 11.1 to 11.9. The unit in Test Position No. 2 had a change from a pretest resonant frequency of 3631 Hz to 3590 Hz after Shot No. 4, a drop of 41 Hz. The "Q" changed from 11.4 at pretest to 11.9 after Shot No. 4 (20' standoff). The unit in Test Position No. 3 had a change in resonant frequency from 3642 Hz at pretest to 3611 Hz after Shot No. 4 (20' standoff), a drop of 31 Hz. The "Q" of this unit at pretest was 11.4 and after the last shot (20' standoff) it was 12.2. The unit in Test Position No. 4 had a noticeable change in "Q" value from 11.8 after Shot No. 1 to 13.5 after Shot No. 2. The METB-2 unit in Test Position No. 6 had a change from pretest resonant frequency of 3795 Hz to 3623 Hz after Shot No. 4 (20' standoff), a drop in resonant frequency of 172 Hz. The "Q" also shifted from 10.6 at pretest to 13.0 after the last shot. This can be noted in Appendix B. A visual inspection of the stave showed that it was bent in at the top of the unit in Test Position 1.

EDO CORPORATION SQS-26(BX)

Edo had four SQS-26(BX) elements in Test Positions 7, 8, 9, and 10. The pretest resonant frequencies ranged from 3995 Hz to 3645 Hz. The "Q" value varied from 6.6 to 10.4. After Shot No. 4 (20' standoff) no admittance loop could be plotted for the element in Test Position No. 7. The element in Test Position No. 8 showed a difference of 138 Hz from a pretest resonant frequency of 3904 Hz to a resonant frequency of 3766 Hz after Shot No. 4. The "Q" value for the element in Test Position No. 8 at pretest was 8.4 and after Shot No. 4, the "Q" value was 9.9. In Test Position No. 10 the element had a change of resonant frequency from 3995 Hz at pretest to 3937 Hz after Shot No. 4, a shift of 58 Hz.

A visual inspection after Shot No. 3 (30' standoff) indicated the tabs on the stave that held the elements in position were bent out, causing the front of the element to be loose in the stave. This condition increased after the next shot.

HAZELTINE CORPORATION SQS-26(BX)

Hazeltine submitted four SQS-26(BX) elements for this test; Test Positions 13, 14, 15, and 16. Pretest resonant frequencies ranged from 3754 Hz to 3743 Hz. The pretest "Q" values ranged from 8.5 to 11.8. The element in Test Position No. 13 had a change in resonant frequency of 3743 Hz at pretest to a resonant frequency of 3453 Hz after Shot No. 4 (20' standoff). The same element had a very noticeable change in "Q" value from 8.5 at pretest to 21.1, after Shot No. 4. The element in Test Position No. 14 had a resonant frequency change from pretest of 3754 Hz to 3539 Hz after Shot No. 4, while the "Q" value of this same unit changed very little. The element in Test Position No. 15 had a change of resonant frequency of 3754 Hz at pretest to 3530 Hz after Shot No. 4.

The "Q" value of the element in Test Position No. 15 shifted from 11.8 at pretest to 8.8 after Shot No. 4. The element in Test Position No. 16 had a shift in resonant frequency from 3748 Hz at pretest to 3364 Hz after Shot No. 4.

On visual inspection after Shot No. 2, it showed that the elements in Test Positions No. 14 and No. 15 had the corprene ring dislodged from front stabilizers. The corprene rings continued to dislodge from the front stabilizers after Shots No. 3 and No. 4. [1]

HONEYWELL CORPORATION SQS-26(BX)

The Honeywell Corporation tested five SQS-26(BX) elements. They were in Test Position No. 18, No. 19, No. 20, No. 21, and No. 22. In Test Position No. 17, a BQS-6 element was tested. Its resonant frequency was 4101 Hz at pretest and dropped to 3764 Hz after Shot No. 4; a difference of 337 Hz during the test. The "Q" value remained stable at 6.7. Elements in Test Position No. 18, No. 19, No. 20, and No. 21 were subjected only to the last shot (20' standoff). These were SQS-26(BX) type elements. The pretest resonant frequency ranged from 3894 Hz to 3747 Hz. The "Q" value of pretest ranged from 7.0 to 10.0. The unit in Test Position No. 18 had a shift from 3862 Hz at pretest to 3792 Hz after Shot No. 4. This same element had a shift in "Q" value of 8.3 at pretest to 11.5 after Shot No. 4. The element in Test Position No. 22 was the only SQS-26(BX) unit of Honeywell that was subjected to all four shots. The resonant frequency of this unit at pretest was 3926 Hz and a resonant frequency of 3895 Hz after Shot No. 4. The "Q" value of this element shifted from 14.5 at pretest to 21.1 after the last shot.

A visual inspection indicated the rear isolation ring dislodged after Shots No. 3 and No. 4 on the element in Test Position No. 17.

[1] For detailed photograph, contact M.E.Evans,Code 2332(EB2)NUSC/NL.

DYNA-EMPIRE INC. TR-167B/BQH-1

Dyna-Empire, Inc., had two units; they were in Test Positions No. 11 and No. 12. These units were modified TR-167B, serial numbers 2 and 1, respectively. These units were not checked for V.A.L.P's. Both units withstood Shots No. 1 (75' standoff), No. 2 (50' standoff), and No. 3 (30' standoff), but failed to function after Shot No. 4 (20' standoff).

A visual inspection indicated no apparent damage to the exterior of these units. No interior inspection was performed at the test site. For more information regarding the TR-167B units, contact Mr. A. Bachran of Dyna-Empire, Inc., Garden City, L. I., New York.

RAYTHEON COMPANY - TR-155

Raytheon Company submitted twelve elements for shock test. Nine of these elements were TR-155 (experimental) transducer. For more detailed information of test positions, types, and serial numbers, see Appendix A.

In Test Position No. 23 was a low frequency dome (DT-511/WLR-9) element. The resonant of this element had very little change from pre-test through the final shot. The element had a "Q" of 53.6 at pretest to 51.9 after the last shot. No VALP's were taken of the element in Test Position No. 24 (DT-512/WLR-9). In Test Positions No. 25 through No. 33 were TR-155 elements. The pretest resonant frequencies ranged from 3625 Hz to 4117 Hz. The "Q" values ranged from 13.5 to 36.3 at pretest. In Test Position No. 27, a dummy element was shocked (no electronics). No admittance loop could be plotted of the element in Test Position No. 31 after Shot No. 4. The "Q" values of elements in Test Positions No. 25, No. 26, No. 29, No. 30, No. 32, and No. 33 had a noticeable change from pretest through the final shot (20' standoff). This change can be seen in Appendix B. The DT-511/WLR element in Test Position No. 34 had very little change in resonant frequencies from pre-test through the last shot (20' standoff). The "Q" value of this element did change and can be noted in Appendix B.

A visual inspection after each shot was made. After Shot No. 1 (75' standoff) the isolation rings at the back of the Units No. 29 and No. 33 squeezed out. After Shot No. 2 (50' standoff) isolation rings on Units No. 29, No. 32, and No. 33 were dislodged. After Shots No. 3 (30' standoff) and Shot No. 4 (20' standoff) the isolation rings on Elements No. 29, No. 31, No. 32, and No. 33 were forced out again.

CONCLUSION

GENERAL ELECTRIC COMPANY

SQS-26(BX)

These elements performed well through the entire test. The resonant frequencies changed very little during the test. The "Q" value shift was insignificant.

METB-2

This element had a small change in resonant frequency. The "Q" value changed from 10.6 to 13.0 during the test.

EDO CORPORATION - SQS-26(BX)

The element in Test Position No. 7 did not function after Shot No.4 (20' standoff). No admittance loop could be plotted. The three remaining elements had small resonant frequencies shifts. The "Q" values was stable during the test.

DYNA-EMPIRE INC. - TR-167B/BQH-1 (Modified)

The two elements of Dyna-Empire were operating after the first three shots, but both units failed to function after Shot No. 4 (20' standoff).

HAZELTINE CORPORATION - SQS-26(BX)

Three of four elements shocked had some changes in resonant frequencies; these elements had a very small shift in the "Q" value. The "Q" value of one element (Test Position No. 13) had a change from 8.5 at pretest to 21.5 after Shot No. 4 (20' standoff). This might indicate a possible mechanical damage to the ceramic.

HONEYWELL CORPORATION

SQS-26(BX)

Only one element was subjected to all four shots. The shift in resonant frequencies of this element was small. The "Q" value of this element had a noticeable change from 14.5 at pretest to 21.1 after Shot No. 4(20' standoff). The other SQS-26(BX) elements were subjected to Shot No. 4 only(20' standoff). One element had a change in "Q"value of 3.2.

HONEYWELL CORP.(cont.)

BQS-6

The resonant frequency of this element dropped 337 Hz during the test. The "Q" value change was very little. The drop in resonant frequency appears to indicate a ceramic problem.

RAYTHEON COMPANY

TR-155

The TR-155 elements consist of a variation of experimental units, therefore the resonant frequencies and the "Q" values of these units could not be compared.

The element in Test Position No. 31 showed no VALP after Shot No. 4 (20' standoff).

DT-511/WLR-9

The resonant frequencies of the DT-511 elements remained constant during the entire test. The "Q" value of these elements did have a shift. The element in Test Position No. 34 had a "Q" value at pretest of 33.4 and after Shot No. 4 (20' standoff) the "Q" value was 41.9.

DT-512/WLR-9

No measurements (VALP's) were taken of this element by NUSC/NL personnel.

Milford E. Evans

MILFORD E. EVANS
Mechanical Engineering Technician

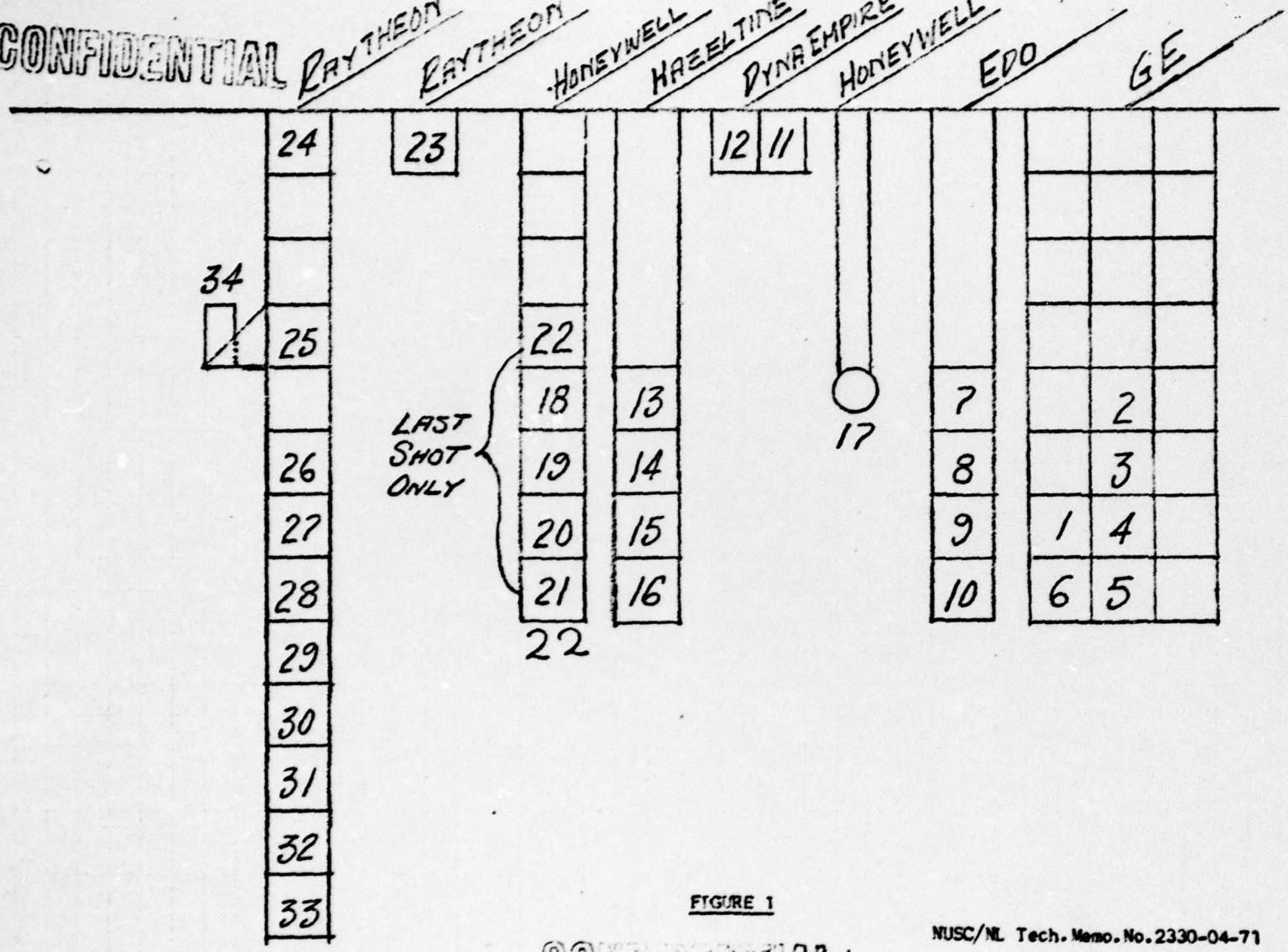

FIGURE 1

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APPENDIX A

GENERAL ELECTRIC COMPANY
Heavy Military Electronic Systems
Syracuse, New York

Test Position Number	NAVSEC FSP Item No.	Description	Serial Number	Approximate Dimensions		Approx. Weight (lb.)	Service/ Ship	Contract Order Number
				Length(in.)	Dia.(in.)			
1	230	Dummy	#2	18"	4"	40	None	None
2	230	SQS-26 (BX)	#14	22"	5"	50	Destroyer	N00024-70-C-1370
3	230	SQS-26 (BX)	#13	22"	5"	50	Destroyer	N00024-70-C-1370
4	230	SQS-26 (BX)	#12	22"	5"	50	Destroyer	N00024-70-C-1370
5	230	SQS-26 (BX)	#15	22"	5"	50	Destroyer	N00024-70-C-1370
6	230	METB-2	#1	26"	4"	50	Submarine	N000140-69-C-0320

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APPENDIX A

EDO CORPORATION

College Point, Long Island, N. Y.

Test Position Number	NAVSEC FSP Item No.	Description	Serial Number	Approximate Dimensions		Approx. Weight (lb.)	Service/ Ship	Contract Order Number
				Length(in.)	Dia.(in.)			
7	241	SQS-26(BX)	21	23	8 x 8 Hd 5 Dia.	50	DE or DL	NObsr 87461
8	241	SQS-26(BX)	23	23	8 x 8 Hd 5 Dia.	50	DE or DL	NObsr 87461
9	241	SQS-26(BX)	10	23	8 x 8 Hd 5 Dia.	50	DE or DL	NObsr 87461
10	241	SQS-26(BX)	28	23	8 x 8 Hd 5 Dia.	50	DE or DL	NObsr 87461

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APPENDIX A

DYNA-EMPIRE, INC.
Garden City, L. I., N. Y.

Test Position Number	NAVSEC FSP Item No.	Description	Serial Number	Approximate Dimensions		Approx. Weight (lb.)	Service/ Ship	Contract Order Number
				Length (in.)	Dia.(In.)			
11	229	Modified TR-167B/BQH-1	#2	9"	8-1/2"	40 less cable	submarine	N00024-69-C-1258
12	229	Modified TR-167B/BQH-1	#1	9"	8-1/2"	40 less cable	submarine	N00024-68-C-1038

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APPENDIX A

HAZELTINE CORPORATION

Braintree, Mass.

Test Position Number	NAVSEC FSP Item No.	Description	Serial Number	Approximate Dimensions		Approx. Weight (lb.)	Service/ Ship	Contract Order Number
				Length (in.)	Dia (in.)			
13	238	SQS-26(BX)	17	22	5	60	Destroyer	N00024-70-C-1371
14	238	SQS-26(BX)	11	22	5	60	Destroyer	N00024-70-C-1371
15	238	SQS-26(BX)	15	22	5	60	Destroyer	N00024-70-C-1371
16	238	SQS-26(BX)	12	22	5	60	Destroyer	N00024-70-C-1371

APPENDIX A

HONEYWELL CORPORATION
Marine Systems Center
Seattle, Washington

Test Position Number	NAVSEC FSP Item No.	Description	Serial Number	Approximate Dimensions		Approx. Weight (lb.)	Service/ Ship	Contract Order Number
				Length(in.)	Dia. (in.)			
17	236	BQS-6	HX278W	26"	4"	50	submarine	None
18	236	SQS-26 (BX)	008	22"	5"	50	destroyer	N00024-70-C-1372
19	236	SQS-26 (BX)	010	22"	5"	50	destroyer	N00024-70-C-1372
20	236	SQS-26 (BX)	014	22"	5"	50	destroyer	N00024-70-C-1372
21	236	SQS-26 (BX)	020	22"	5"	50	destroyer	N00024-70-C-1372
22	236	SQS-26 (BX)	Engineering Model #12	22"	5"	50	destroyer	N00024-70-C-1372

APPENDIX A

RAYTHEON COMPANY

Submarine Signal Division
Portsmouth, Rhode Island

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Test Position Number	NAVSEC FSP Item No.	Description	Serial Number	Approximate Dimensions		Approx. Weight (lb.)	Service/ Ship	Contract Order Number
				Length(in.)	Dia.(in.)			
23	240	Low Freq. Dome and DT-511/WLR-9	Ex - 2	Dome: 28x11x22 Xducer: 15"	6"	60	submarine	?
24	240	DT-512/WLR-9	A-2	18"	4"	25	submarine	?
25	240	TR-155	EXP - #9	21"	4-1/4	60	submarine	
26	240	TR-155	EXP - #1	21"	4-1/4"	60	submarine	
27	240	TR-155	Dummy EXP - #7	21"	4-1/4"	60	submarine 687	No Contract No.
28	240	TR-155	EXP - #4	21"	4-1/4"	60	submarine Class	IDP.
29	240	TR-155	EXP - #8	21"	4-1/4"	60	submarine	RAYTHEON
30	240	TR-155	EXP - #14	21"	4-1/4"	60	submarine	FUNDED
31	240	TR-155	EXP - #13	21"	4-1/4"	60	submarine	
32	240	TR-155	EXP - #5	21"	4-1/4"	60	submarine	
33	240	TR-155	EXP - #15	21"	4-1/4"	60	submarine	
34	240	DT-511/WLR-9	EX - 1	15"	6"	60	submarine	?

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APPENDIX B

Shot No. 0	-	Represents Pretest Data
Shot No. 1	-	Represents Post 75 Ft. Standoff Data
Shot No. 2	-	Represents Post 50 Ft. Standoff Data
Shot No. 3	-	Represents Post 30 Ft. Standoff Data

Nomenclature -

F1 and F2	-	1/2 Power Frequencies in Hz
FR	-	The First Resonant Frequency in Hz
Q	-	Defined as FR (F2-F2)
DFR	-	The Change in FR From the Previous Shot

U.E.R.D. TEST DATA M.E. EVANS

	F1	FR	F2	U	DFR
TEST POSITION No.2					
SHOT NO. 0	3480.	3631.	3799.	11.4	.0
SHOT NO. 1	3474.	3615.	3785.	11.6	-16.0
SHOT NO. 2	3474.	3616.	3788.	11.5	1.0
SHOT NO. 3	3459.	3597.	3768.	11.6	-19.0
SHOT NO. 4	3455.	3590.	3754.	11.9	-7.0
TEST POSITION No.3					
SHOT NO. 0	3495.	3642.	3813.	11.4	.0
SHOT NO. 1	3482.	3623.	3792.	11.7	-19.0
SHOT NO. 2	3486.	3630.	3795.	11.5	7.0
SHOT NO. 3	3482.	3619.	3782.	12.1	-11.0
SHOT NO. 4	3476.	3611.	3771.	12.2	-8.0
TEST POSITION No.4					
SHOT NO. 0	3509.	3651.	3816.	11.9	.0
SHOT NO. 1	3499.	3643.	3809.	11.8	-8.0
SHOT NO. 2	3519.	3643.	3789.	13.3	.0
SHOT NO. 3	3505.	3633.	3783.	13.1	-10.0
SHOT NO. 4	3481.	3620.	3781.	12.1	-13.0
TEST POSITION No.5					
SHOT NO. 0	3479.	3631.	3807.	11.1	.0
SHOT NO. 1	3466.	3614.	3786.	11.3	-17.0
SHOT NO. 2	3474.	3614.	3781.	11.3	.0
SHOT NO. 3	3456.	3600.	3770.	11.5	-14.0
SHOT NO. 4	3457.	3597.	3759.	11.9	-3.0
TEST POSITION No.6					
SHOT NO. 0	3656.	3795.	4015.	10.6	.0
SHOT NO. 1	3642.	3776.	3989.	10.9	-19.0
SHOT NO. 2	3619.	3742.	3939.	11.7	-34.0
SHOT NO. 3	3661.	3780.	3959.	12.0	18.0
SHOT NO. 4	3539.	3623.	3818.	13.0	-137.0
TEST POSITION No.7					
SHOT NO. 0	3664.	3865.	4127.	8.3	.0
SHOT NO. 1	3668.	3859.	4096.	9.0	-6.0
SHOT NO. 2	3674.	3860.	4103.	9.0	1.0
SHOT NO. 3	3630.	3840.	4076.	8.0	-20.0
SHOT NO. 4	1000.	2000.	3000.	1.0	-1840.0
TEST POSITION No.8					
SHOT NO. 0	3690.	3904.	4153.	8.4	.0
SHOT NO. 1	3665.	3882.	4125.	8.0	-22.0
SHOT NO. 2	3692.	3884.	4135.	8.8	2.0
SHOT NO. 3	3669.	3863.	4088.	9.2	-21.0
SHOT NO. 4	3568.	3760.	3969.	9.9	-97.0
TEST POSITION No.9					
SHOT NO. 0	3401.	3645.	3950.	6.6	.0
SHOT NO. 1	3363.	3603.	3913.	6.6	-42.0
SHOT NO. 2	3362.	3589.	3934.	6.5	-14.0
SHOT NO. 3	3354.	3577.	3871.	6.9	-12.0
SHOT NO. 4	3303.	3499.	3794.	7.1	-78.0

U.C.R.D. TEST DATA R.E. EVANS

	F1	FR	F2	Q	DFR
TEST POSITION No. 10					
SHOT NO. 0	3823.	3995.	4208.	10.4	.0
SHOT NO. 1	3822.	3983.	4174.	11.3	-12.0
SHOT NO. 2	3819.	3979.	4170.	11.3	-4.0
SHOT NO. 3	3810.	3972.	4163.	11.3	-7.0
SHOT NO. 4	3772.	3937.	4120.	11.3	-35.0
TEST POSITION No. 13					
SHOT NO. 0	3544.	3743.	3986.	8.3	.0
SHOT NO. 1	3537.	3709.	3935.	9.3	-34.0
SHOT NO. 2	3530.	3686.	3881.	10.3	-21.0
SHOT NO. 3	3467.	3644.	3872.	9.0	-44.0
SHOT NO. 4	3406.	3453.	3650.	21.1	-191.0
TEST POSITION No. 14					
SHOT NO. 0	3557.	3754.	3995.	8.3	.0
SHOT NO. 1	3527.	3710.	3924.	9.3	-44.0
SHOT NO. 2	3514.	3688.	3893.	9.7	-22.0
SHOT NO. 3	3465.	3642.	3862.	9.2	-46.0
SHOT NO. 4	3308.	3539.	3740.	9.3	-103.0
TEST POSITION No. 15					
SHOT NO. 0	3565.	3754.	3982.	11.3	.0
SHOT NO. 1	3543.	3719.	3940.	9.4	-35.0
SHOT NO. 2	3531.	3711.	3990.	8.1	-8.0
SHOT NO. 3	3500.	3691.	3917.	8.9	-20.0
SHOT NO. 4	3364.	3530.	3765.	8.3	-161.0
TEST POSITION No. 16					
SHOT NO. 0	3565.	3748.	3980.	9.0	.0
SHOT NO. 1	3526.	3717.	3952.	8.7	-31.0
SHOT NO. 2	3543.	3733.	3937.	9.3	16.0
SHOT NO. 3	3355.	3523.	3743.	9.1	-210.0
SHOT NO. 4	3226.	3364.	3561.	10.0	-159.0
TEST POSITION No. 17					
SHOT NO. 0	3734.	4101.	4343.	6.7	.0
SHOT NO. 1	3705.	4046.	4327.	8.3	-55.0
SHOT NO. 2	3765.	4173.	4327.	7.4	132.0
SHOT NO. 3	3726.	4047.	4329.	6.7	-131.0
SHOT NO. 4	3666.	3764.	4165.	6.7	-285.0
TEST POSITION No. 18					
SHOT NO. 0	3638.	3862.	4105.	8.3	.0
SHOT NO. 1	1000.	2000.	3000.	1.0	-1862.0
SHOT NO. 2	1000.	2000.	3000.	1.0	.0
SHOT NO. 3	1000.	2000.	3000.	1.0	.0
SHOT NO. 4	3637.	3792.	3966.	11.5	1792.0
TEST POSITION No. 19					
SHOT NO. 0	3529.	3747.	4067.	7.0	.0
SHOT NO. 1	1000.	2000.	3000.	1.0	-1747.0
SHOT NO. 2	1000.	2000.	3000.	1.0	.0
SHOT NO. 3	1000.	2000.	3000.	1.0	.0
SHOT NO. 4	3490.	3751.	4160.	5.0	1751.0

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	F1	FR	F2	Q	DFR
TEST POSITION No.20					
SHOT NO. 0	3717.	3894.	4108.	10.0	.0
SHOT NO. 1	1000.	2000.	3000.	1.0	-1894.0
SHOT NO. 2	1000.	2000.	3000.	1.0	.0
SHOT NO. 3	1000.	2000.	3000.	1.0	.0
SHOT NO. 4	3691.	3868.	4059.	10.5	1868.0
TEST POSITION No.21					
SHOT NO. 0	3694.	3864.	4090.	9.8	.0
SHOT NO. 1	1000.	2000.	3000.	1.0	-1884.0
SHOT NO. 2	1000.	2000.	3000.	1.0	.0
SHOT NO. 3	1000.	2000.	3000.	1.0	.0
SHOT NO. 4	3665.	3829.	4015.	10.9	1829.0
TEST POSITION No.22					
SHOT NO. 0	3796.	3926.	4067.	14.5	.0
SHOT NO. 1	3812.	3895.	3979.	23.5	-31.0
SHOT NO. 2	3823.	3895.	3971.	26.5	.0
SHOT NO. 3	3805.	3903.	4014.	18.7	8.0
SHOT NO. 4	3807.	3895.	3992.	21.1	-8.0
TEST POSITION No.23					
SHOT NO. 0	6556.	6653.	6717.	53.6	.0
SHOT NO. 1	6548.	6628.	6716.	51.4	-5.0
SHOT NO. 2	6545.	6630.	6718.	49.9	2.0
SHOT NO. 3	6547.	6627.	6714.	51.7	-3.0
SHOT NO. 4	6544.	6623.	6710.	51.9	-4.0
TEST POSITION No.25					
SHOT NO. 0	3497.	3625.	3729.	15.6	.0
SHOT NO. 1	3864.	4145.	4223.	11.5	520.0
SHOT NO. 2	3576.	3773.	3890.	12.0	-372.0
SHOT NO. 3	3782.	4064.	4112.	12.5	291.0
SHOT NO. 4	3645.	4024.	4090.	9.0	-40.0
TEST POSITION No.26					
SHOT NO. 0	3866.	4045.	4147.	14.5	.0
SHOT NO. 1	3922.	4060.	4121.	20.4	15.0
SHOT NO. 2	3940.	4065.	4112.	25.6	5.0
SHOT NO. 3	3862.	4057.	4127.	15.5	-8.0
SHOT NO. 4	3906.	4039.	4095.	21.6	-18.0
TEST POSITION No.28					
SHOT NO. 0	4016.	4117.	4191.	25.5	.0
SHOT NO. 1	3977.	4089.	4157.	22.7	-28.0
SHOT NO. 2	3993.	4096.	4152.	25.8	9.0
SHOT NO. 3	3935.	4090.	4160.	18.2	-2.0
SHOT NO. 4	3956.	4067.	4120.	24.8	-29.0
TEST POSITION No.29					
SHOT NO. 0	4005.	4106.	4159.	26.7	.0
SHOT NO. 1	4014.	4086.	4147.	30.7	-18.0
SHOT NO. 2	3995.	4066.	4122.	32.6	-22.0
SHOT NO. 3	3947.	4066.	4131.	22.1	.0
SHOT NO. 4	3937.	4020.	4075.	29.1	-46.0

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	F1	FR	F2	Q	UFR
TEST POSITION No.30					
SHOT NO. 0	3881.	4044.	4100.	13.5	.0
SHOT NO. 1	3715.	3943.	4006.	13.5	-101.0
SHOT NO. 2	3881.	3946.	4003.	12.3	3.0
SHOT NO. 3	3295.	3345.	3519.	14.9	-601.0
SHOT NO. 4	3351.	3393.	3499.	22.9	48.0
TEST POSITION No.31					
SHOT NO. 0	4025.	4099.	4175.	27.3	.0
SHOT NO. 1	4029.	4094.	4151.	33.3	-5.0
SHOT NO. 2	4004.	4080.	4143.	29.4	-8.0
SHOT NO. 3	4203.	4275.	4353.	28.5	189.0
SHOT NO. 4	1000.	2000.	3000.	1.0	-2275.0
TEST POSITION No.32					
SHOT NO. 0	3964.	4107.	4241.	14.8	.0
SHOT NO. 1	3990.	4110.	4196.	20.0	3.0
SHOT NO. 2	4029.	4110.	4175.	28.2	.0
SHOT NO. 3	4011.	4111.	4202.	21.3	1.0
SHOT NO. 4	3906.	4051.	4122.	18.3	-60.0
TEST POSITION No.33					
SHOT NO. 0	3959.	4034.	4070.	36.3	.0
SHOT NO. 1	4013.	4056.	4097.	48.3	22.0
SHOT NO. 2	3925.	4011.	4199.	14.6	-45.0
SHOT NO. 3	3963.	4039.	4078.	42.3	28.0
SHOT NO. 4	3961.	4012.	4048.	46.1	-27.0
TEST POSITION No.34					
SHOT NO. 0	8094.	8254.	8341.	33.4	.0
SHOT NO. 1	8066.	8260.	8343.	32.1	6.0
SHOT NO. 2	8096.	8257.	8342.	33.6	-3.0
SHOT NO. 3	8154.	8263.	8335.	45.7	6.0
SHOT NO. 4	8136.	8252.	8335.	41.9	-11.0
TEST POSITION					